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Magnet Division Procedure

Procedure: SMD-GSI-RD3002

Revision: A



GSI Coil Assembly and Measurements

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Revision History

Rev. A Initial Release 11/18/02

1 Scope:

This procedure details the steps necessary to inspect, clean, insulate and test coils after winding and curing. It also describes requirements for the measurement of coil azimuthal size. The deviation of the coil azimuthal size from the design value is determined to confirm the correct coil size and to check that the range of pre-compression will be correct during collaring. The procedure to measure the coil size is performed at preset positions along the longitudinal length of the coil as defined in the procedure.

The procedure also describes the method used to measure the longitudinal straight section length; the overall length and end lengths of an individual coil, using the GAC (Grumman Aerospace Corporation) built coil measurement fixture.

2 Applicable Documents:

The following documents in effect on the date of issue of this specification form a part of this specification.

RHIC-MAG-Q-1004	Discrepancy Reporting Procedure
RHIC-MAG-R-7225	RHIC Dipole/Quadrupole Visual Inspection
RHIC-MAG-R-7227	RHIC Electrical Resistance Measurement
RHIC-MAG-R-7228	RHIC Inductance and Q Measurements
RHIC-MAG-R-7318	RHIC Impulse Testing
GAC Dwg. 120100007-SPM	8cm Dipole Coil Compression Gauge

3 Requirements:

3.1 Material/Equipment:

8cm Dipole Lead Ramp Solder Fixture Assembly
8cm Dipole Mid-plane Lead Solder Fixture Assembly

LVDT With Digital Readout	RDP Electrosense, Inc.
	Probe D5/40G8
	Meter E525-115-AC-O-0

Vernier caliper with measuring accuracy " 0.001 inches. (0-8 in. range)

3.2 Safety Precautions

3.2.1 Proper eye protection (safety glasses, goggles) must be worn during coil measuring, cleaning or soldering operations. Failure to observe this precaution may result in eye injury.

3.2.2 Work areas must be adequately vented when using solvents. No sparks or flames are allowed in the work area. Failure to observe this precaution may result in fire. Dispose of all solvent wetted materials in proper containers. Proper protective gloves are to be used as prescribed, when using solvents.

3.2.3 The technicians shall be instructed by their cognizant technical supervisor in the operation of the required electrical test equipment and the electrical testing procedures. They shall be familiar with the latest revision of the applicable documents referenced in Section 2.

In addition, some of these tests require the technician to have special training. A list of qualified personnel shall be maintained with the Training Coordinator.

3.2.4 Some of these electrical test procedures have specific safety requirements. The technicians performing these specific tests shall rigorously follow all the safety requirements listed as well as those prescribed by the BNL ES&H Standard.

3.2.5 All guards and barriers must be in place.

3.2.6 The technicians shall be qualified in the operation of hydraulic equipment.

3.2.7 Specific steps of this procedure contain electrical and mechanical assembly operations that impact the environment. Prior to performing these steps, personnel shall complete the applicable facility specific environmental training.

- 4 Procedure
- 4.1 Visual Inspection and Preparation of Coil Surfaces
- 4.1.1 Complete a visual inspection of the coil following RHIC-MAG-R-7225. Use acetone solvent and paper towels to remove any dust, grit or remaining mold release from coil surfaces.
- 4.2 Calibration of Coil Azimuthal Size Measurement Equipment

NOTE

Coil Size - The azimuthal size is from 0.004 in. below the midplane to the pole surface as shown in Figure below, and is measured and recorded as deviations in thousandths of an inch from a standard coil size which matches the magnetic coil design.

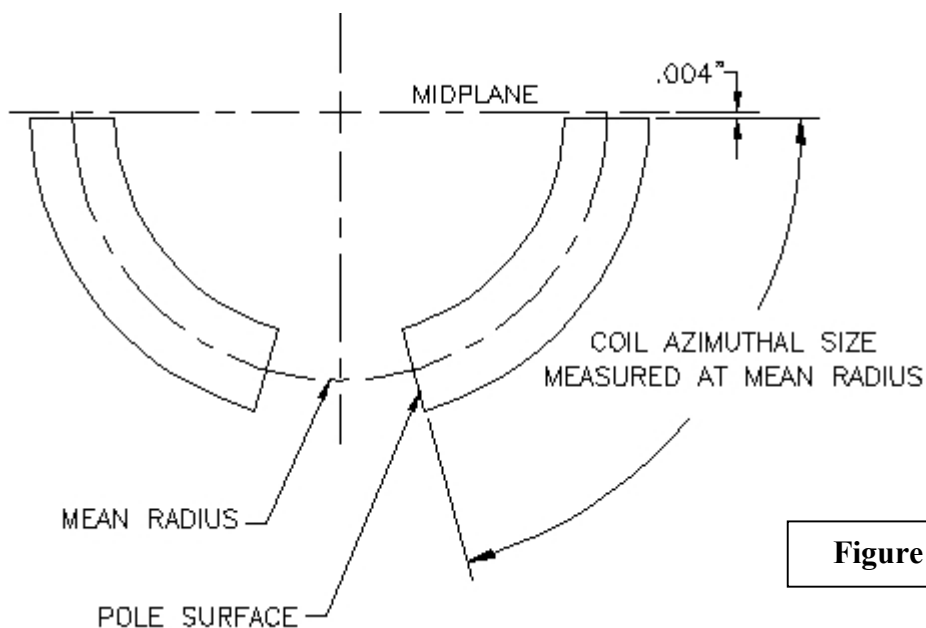


Figure 1

- 4.2.1 Place coil reference standards in their proper orientations (as marked on each part) against each standard shim. Red right/Green left.
- 4.2.2 Place shims on the top surfaces of the reference standards .010" right/.009" left.

CAUTION

Hydraulics applied.

Hydraulic pressure will cause the Compression Fixture to move – make sure area is clear of personnel and equipment prior to proceeding. Eye protection must be worn.

- 4.2.3 Pull back the ENERPAC lever to the pressure release position. Turn “ON” the hydraulic pump (switch located on the read out console). Push lever forward past neutral to the pressure applied position. The hydraulic pressure is set at 8000 PSIG. If necessary, adjust the pressure at the pump using the pressure relief valve.

NOTE

Hydraulic pressure of 8000 PSIG results in a coil stress of 10,000 PSI.

- 4.2.4 Using the LVDT Digital Readout Meter, zero both LVDT’s by pressing “ZERO” and “MODE 1” (#1 LVDT) simultaneously, then press “ZERO” and “MODE 2” (#2 LVDT) simultaneously.

NOTE

Remove the coil stands to allow the coil compression fixture to pass. Replace the stands when the fixture is clear of stand mounts.

- 4.2.5 Release the hydraulic pressure. Repeat the compression cycle to make certain the meter reading returns to zero within 0.0003 in. Release the hydraulic pressure. Add 0.003 in. thick shims, from the shim assortment, to the standard shims. The meter readings should be $.003 \pm .0003$ in. If not, repeat the calibration procedure, section 4.2.1-4.2.4.
- 4.2.6 Remove the coil reference standards and shims. Locate the coil in the compression fixture at the initial measuring position. See figure below. Be sure the coil is properly cradled.

LOCATION OF MEASURING POSITIONS FOR
DETERMINATION OF GSI 8CM DIPOLE COIL SIZE

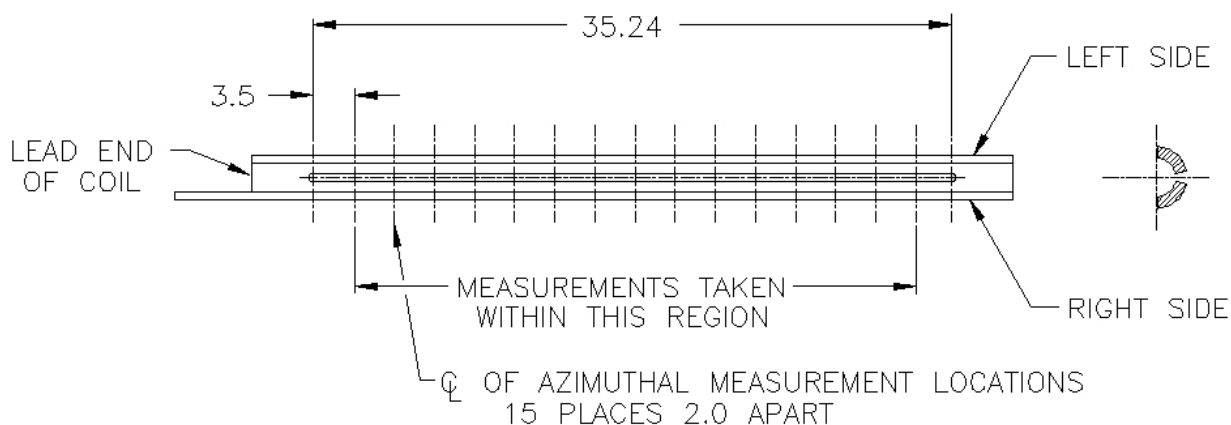


Figure 2

DIMENSIONS IN INCHES

4.3 Azimuthal Size Measurement

CAUTION

Hydraulics applied.

Hydraulic pressure will cause the Compression Fixture to move – make sure area is clear of personnel and equipment prior to proceeding. Eye protection must be worn.

- 4.3.1 Apply 8000 PSIG hydraulic pressure.
- 4.3.2 With the 8000 PSIG applied, when the meter readings are stabilized at $0 \pm .005$ in., enter the required data into the traveler.
- 4.3.3 Close the hydraulic valve to release the hydraulic pressure.
- 4.3.4 Repeat steps 4.3.1 to 4.3.3 for the remaining measurement positions as shown in the figure.

Position	Distance from LE SS	Left	Right
1	3.5		
2	5.50		
3	7.5		
4	9.5		
5	11.5		
6	13.5		
7	15.5		
8	17.5		
9	19.5		
10	21.5		
11	23.5		
12	25.5		
13	27.5		
14	29.5		
15	31.5		

Figure 3

Length Data:

LE Indicator: _____

NL Indicator: _____

Invar Bar: _____

Overall Length: _____

LE Length: _____

NL Length: _____

Straight Sect: _____

4.4 Check Calibration

4.4.1 After completion of all measurements along the coil, recheck the fixture calibration. (Section 4.2.1-4.2.4) If the calibration does not check out, the coil should be re-measured after the calibration problem is corrected.

4.5 Coil Length Measurement

4.5.1 Place a flat block on the dial indicator plunger of SHT6-1 gage angle assembly. Fully depress the plunger until the block rests tightly against the vertical face of the gage angle assembly. Set the dial indicator to zero, the –1 assembly has no step in the lower edge.

4.5.2 Place SHT6-1 and SHT6-3 gage angle assemblies on a flat surface facing each other. Bring them together until the step at the lower edge of the –3 assembly is firmly in

contact with the face of the –1 assembly and the dial indicator plunger of the –3 assembly is against the face of the –1 assembly. Immediately adjacent to the cutout for the dial indicator of the –1 assembly set the dial indicator on the –3 gage angle assembly to zero.

- 4.5.3 Place the SHT6-3 gage angle assembly on the flat plate on the non-lead end of the fixture. Place the assembly against the gear rack and slide it toward the coil until the step at the lower edge of the front face contacts the fitting at the end of the invar bar. Record dial indicator reading.
- 4.5.4 Repeat steps 4.5.1-4.5.3 using the SHT6-1 gage angle assembly at the lead end of the fixture.
- 4.5.5 Record the dimension for the length of the invar bar marked on the metal tag on the end fitting.
- 4.5.6 Place one SHT12-27 pole piece adapter into the non-lead end saddle of the coil and secure with a “Wheat Thin”, screw and modified insulator.
- 4.5.7 Repeat step 4.5.1-4.5.6 for the other end of the coil.
- 4.5.8 Using a micrometer or dial caliper measure the distance from the end of the coil to the flat surface of the (SHT12-27) pole adapter and record.
- 4.5.9 Repeat step 4.5.1-4.5.8 for other end of coil.
- 4.5.10 Calculate the straight section length and overall length of coil and record.
- 4.6 Radial Thickness Measurements
- 4.6.1 Measure the coil end radial thickness at 3 places on each end as shown in figure below . Record data.
- 4.6.2 Verify that the thickness is within tolerance .391-.403.

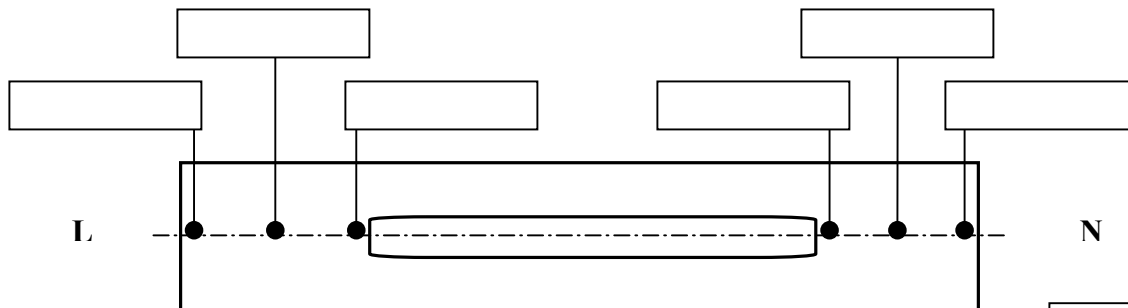


Figure 4

4.7 Electrical Tests

NOTE

Record all electrical test data in the traveler.

- 4.7.1 Complete the electrical resistance measurement of the coil following RHIC-MAG-R-7227.
- 4.7.2 Complete the measurements of inductance and quality factor (Q) on the coil following RHIC-MAG-R-7228.
- 4.7.3 Complete the impulse testing of the coil following RHIC-MAG-R-7318. The test must be completed so the turn-to-turn voltage is ≥ 50 volts.
- 4.7.4 Complete the electrical resistance measurement of the coil following RHIC-MAG-R-7227.
- 4.7.5 Complete the measurements of inductance and quality factor (Q) on the coil following RHIC-MAG-R-7228.
- 4.8 Solder Copper Stabilizer Cable to Coil Leads
- 4.8.1 Strip Kapton insulation from the pole lead as shown on the coil assembly drawing.
- 4.8.2 Solder the copper stabilizer cable to the coil pole lead as shown on the coil assembly drawing. All soldering shall be done using silver bearing solder ribbon (P/N 12020421-01) and non-corrosive flux (P/N 12010069).

NOTE

Ensure unused solder is recycled or disposed of properly

- 4.8.3 Inspect soldered thickness and height and record on data sheet. See Figure. Required thickness = $.095 \pm .001$; height = $.392 \pm .002$.

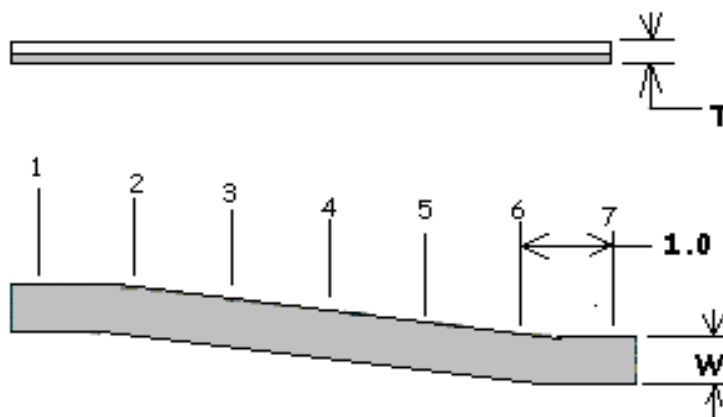


Figure 5

- 4.8.4 Clean the soldered stabilizer connection thoroughly with acetone.
- 4.8.5 Wrap the coil pole lead and attached copper stabilizer with Kapton insulation (P/N 12010181-08) as shown on the coil assembly drawing. The wraps are to be staggered by half the width of the $\frac{1}{2}$ -in. Kapton.
- 4.8.6 Repeat Steps 4.8.1-4.8.2 and 4.8.4-4.8.5 for coil midplane lead.
- 4.9 Apply Kapton Insulation
- 4.9.1 Clean the coil with acetone. Inspect the coil to be sure it is free of metallic chips, abrasions or other abnormalities. Correct defects prior to installation of insulation in steps below.

CAUTION

Personal Injury - Burns

Care must be taken when using a hot iron. Failure to observe this caution may result in personal injury.

- 4.9.2 Install creased Kapton caps on both mid-plane surfaces of the coil as shown on the coil assembly drawing using a hot iron at a temperature of 150⁰C.
- 4.9.3 Install creased Kapton caps on both pole turn surfaces of the coil as shown on the coil assembly drawing using a hot iron at a temperature of 150⁰C. Install Kapton caps on coil ends as shown on the assembly drawing.
- 4.10 Install pole spacers
- 4.10.1 Install the non-lead end pole spacer as shown on the coil assembly drawing. Use Kapton tape (.0005 in. thick) to hold the pole spacer in place.
- 4.10.2 Install the lead end pole spacer assembly as shown on the coil assembly drawing.
- 4.11 Final Preparation
- 4.11.1 Install the lead ramp assembly as shown on the coil assembly drawing. Secure in place temporarily with velcro strap.
- 4.11.2 Secure midplane and pole leads to coil with velcro straps.
- 4.11.3 Roll up excess coil leads and secure with cable ties.
- 4.11.4 Place coil on storage rack and cover with plastic.

5 Quality Assurance Provisions

5.1 The Quality Assurance provisions of this procedure require that the technician shall be responsible for performing all assembly operations in compliance with the procedural instructions contained herein and the recording of the results on the production traveler.

5.2 The technician is responsible for notifying the technical supervisor and/or the cognizant engineer of any discrepancies occurring during the performance of this procedure. All discrepancies shall be identified and reported in accordance with RHIC-MAG-Q-1004.

5.3 Measuring and test equipment used for this procedure shall contain a valid calibration label in accordance with RHIC-MAG-Q-1000.

5.4 Verify the calibration for the following equipment is current:

Master Coil Segments
Hydraulic Pressure Gauge
Vernier caliper
Dial indicators
Invar rods

6 Product Handling

6.1 Because coils are very delicate, care must be exercised in their handling at all times. Cleanliness is also of importance in handling coils. The work area must be free of any metallic chips or other foreign matter. Coils must not be touched with any markers which will leave conducting residue, e.g., graphite pencils, etc.

7 Preparation for Delivery:

N/A